

November 30, 1972

MEMORANDUM FOR

Dr. Edward E. David

SUBJECT: Analysis of Possible Benefits and Risks of Proposed
Joint U.S. - Soviet Program in Chemical Catalysis.

Background

Chemical catalysts are materials which increase the rate of a chemical reaction without themselves entering into the reaction. Although catalysts have been used for many years, their detailed structure and mechanism of functioning is often not well understood. Typical catalysts include rare metals such as platinum, or oxides of transition metals such as iron and chromium which may be deposited on non-reactive solids such as pellets of alumina. Liquids or gases react more effectively when they come in contact with such heterogeneous catalysts. Catalysts, such as organometallic complexes, which dissolve directly in reacting liquids are also available, and these are called homogeneous catalysts.

The principal R&D activity on chemical catalysis in the United States is in the chemical and petroleum industries, and in specialized industrial concerns which manufacture catalysts and market or license complete catalytic processes. Basic research programs on chemical catalysis in the universities and in Federal and non-profit laboratories play a much smaller role. Although the development of catalytic materials is a highly empirical and extremely proprietary business, this enterprise in the United States has been remarkably successful.

A large effort has been invested in basic research in chemical catalysis in the USSR, reflecting a long tradition of attention to this area. The principal research activity is in academy institutes, and in several industrial institutes. Although the total effort in the USSR is probably several times that in the U.S. and the basic research work has been of good quality, Soviet results in terms of practical industrial processes have been meager. This no doubt reflects the problems of an over-structured R&D enterprise with its accompanying inflexibilities, lack of incentive, and difficulties in technology transfer, from basic research to development organizations.

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Although U.S. industrial technology is well ahead of that of the Soviets, the quality of the basic research efforts in the two countries are comparable with the U.S. clearly ahead in some areas, but the Soviets ahead in others. Thus, in designing a joint program with the Soviets in this area, the dominant U.S. concern is not to compromise proprietary industrial technology. U.S. companies protect this information carefully, and in fact it is not shared among research groups in this country. It is thus in the U.S. interest to drive the areas of agreement as far as possible into the basic research area. The Soviet concern, on the other hand, is that their basic work will be exploited by U.S. industry which has been far more resourceful than their own. In fact, there are a number of examples in recent years where just this has occurred.

Specific Proposals

I. Catalysis by coordination complexes and organometallic compounds: In this area the Soviets have done pioneering, basic research work, most notably their work on nitrogen binding chemical complexes at the laboratories of Drs. Shilov and Volpin. There is also strength in basic research in this area in the U.S. This is the highest priority program for the U.S. since it would be of advantage to us to learn the details of the synthetic techniques of Shilov and Volpin. In this project, neither we nor the Soviets would directly acquire anything of commercial or military benefit. In a long range basic research project of this sort, the objective is of course to develop materials and processes of potential practical importance. The ownership and exploitation of such results of basic research will depend upon patent guidelines, and on the resourcefulness of development and marketing organizations. In this arena, U.S. organizations should be very competitive. In terms of potential benefits to the U.S., this project is priority 1.

II. Catalytic reactor modeling: In this area, the Soviets seem to have some experience in the development of analytical models although the relationship of the models to experimental experience and their use of modern computational methods is weak. There is much greater experience in the U.S. in relating models of this sort to practical industrial reactors and to the use of computers. I believe it would be advantageous to the U.S. to learn more about the Soviet analytical methods, but more advantageous to the Soviets to learn about U.S. experimental and computational methods. The program is limited to basic areas involving principally university research groups so that U.S. proprietary industrial technology should not be seriously exposed. This program should result in an improved understanding of the principles of reactor design, but it is not likely that it would lead to a product of commercial or military importance. This is the project in which the Soviets probably have more to gain than the U.S. so in terms of benefit to the U.S. it would be priority 5.

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III. An in-depth study of selected catalytic systems. This proposal involves the application of chemical and physical methods to the study of several standard catalytic systems. In this area, Soviet kinetic and physical chemical methods for the characterization of catalysts may be ahead of those in the U.S. so we probably have something to learn here. On the other hand, U.S. instrument methods are superior to those of the Soviets, although they have unique strength in several specialties such as Mossbauer and Mass Spectroscopy. This project is primarily an effort at standardization of methods for the study of catalytic materials, and in my judgment it benefits both sides with no evident advantage to either. I rank this proposal priority 2 in the U.S. interest.

IV. Application of catalysis to life support systems for possible use in future space exploration: The programs in both countries in this area are still primitive. Programs in the U.S. have been largely under the support of NASA, and thus have automatically been in the public domain. The sharing of information, and the division of labor on potentially promising new approaches does not threaten U.S. security or commercial interests. Both sides should benefit in terms of a reduction in overall R&D costs in support of manned space programs. I rank this proposal as priority 4 in terms of U.S. interest.

V. Catalysis in environmental control: The prospects for developing effective catalysts for nitrogen oxide decomposition are remote, and do not compete with the current large U.S. industrial effort for catalytic reduction of the oxides of nitrogen. The identification of common research goals and the division of research effort among various possible approaches can be done in a way which provides a reduction in costs to both sides. If a useful product is in fact developed in this program, the ultimate ownership of the discovery, and its exploitation will presumably be determined by the patent process and litigation, and the resourcefulness of development and marketing organizations. This proposal is priority 3.

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